

Intergeneric behavior between *Sotalia fluviatilis guianensis* and *Tursiops truncatus* in captivity

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Abstract

Presented the first observations on captive intergeneric behavior between the coastal tucuxi, *Sotalia fluviatilis guianensis*, and the Atlantic bottlenosed dolphin, *Tursiops truncatus*. The behavioral interactions between members of these two delphinid genera fall into three basic categories: 1. passive social interactions, 2. active sexual interactions, and 3. active aggressive interactions. The extent to which one or more of these categories is expressed appears to be determined by the ratio of individuals, and perhaps sexes, present in either species. In general, the *Sotalia* demonstrate more aggressive interactions with the *Tursiops* when their social unit is maintained. Individual *Sotalia* males placed in contact with several *Tursiops* tend to be passive and dependent upon the larger dolphins in their behavioral displays. Courtship displays and attempts at copulation between a male *Sotalia* and a female *Tursiops* were observed.

Introduction

The arguments for increased efforts to study the biology of dolphins in their natural environments are currently pervasive and well-founded. At the same time, however, many of the most fundamental behaviors, easily observed in captivity, are either difficult or logistically impossible to study in the wild. In addition, monetary and geographic limitations (especially those imposed by aquatic habitats) realistically preclude observational studies on a number of species in their normal environments. For the present, at least, the opportunities afforded by captive environments for increasing our knowledge of cetacean biology need to be better explored.

The tucuxi, *Sotalia fluviatilis*, is a small, South American delphinid which inhabits both the Amazon River system and Orinoco estuary, as well as marine waters from the north eastern coast of South America to as far south as Santos, Brazil. The taxonomy of *Sotalia* at present is in a state of flux, and the exact disposition of the number of species or subspecies within the genus cannot be determined until more information is available. There appear to be several populations of *Sotalia fluviatilis*, varying widely in several physical attributes as well as in their utilization of marine and freshwater habitats (WATSON 1980). For the time being, it is assumed that only one species exists, with separate geographical populations being designated as subspecies (VAN BREE 1983; WATSON 1980).

The existence of this small dolphin in captivity has been rare to date. Observations on its behavior have been limited to a male at the Niagara Falls Aquarium (SPOTTE 1967) and a female and her calf at Marineland of Florida (CALDWELL and CALDWELL 1970). In each case, the specimens observed were from the Amazon River and therefore probably *Sotalia fluviatilis fluviatilis* (GERVAIS 1853). One of the studies (SPOTTE 1967) described the intergeneric behavior of the riverine *Sotalia* and two Amazon River dolphins, *Inia geoffrensis*, a platanistid species that co-exists with *Sotalia fl. fluviatilis* throughout much of the Amazon River system. Unconfirmed reports persist from earlier field observations

(LAYNE 1958; HERALD 1967) that the riverine *Sotalia* is sometimes aggressive and will attack *Inia* in their natural habitat; however, there has been no direct verification of this behavior.

Material and methods

In 1977, a number of *Sotalia fluviatilis guianensis* (VAN BENEDEN 1864), collected in the coastal waters of Columbia, were transported to various sites in Europe (BÖSENECKER 1978). Three of these individuals in Antwerp, Belgium, the general captive behavior of which has been described in an earlier paper (TERRY 1983), are subjects in the current study.

The facilities at the dolphinarium in the Antwerp Zoo presently contain, in addition to the three mature *Sotalia* (two males and one female), six Atlantic bottlenosed dolphins, *Tursiops truncatus* (Montagu, 1821). Four of the *Tursiops*, collected from the Gulf of Mexico, have been in captivity for three years. Of these, two are adult females and two are immature males; both females have been pregnant at least once, and one is the mother of a juvenile male. The remaining two *Tursiops* are mature females, both of whom have been at Antwerp for over ten years. These two females were immature when captured and have not been pregnant during their stay in captivity.

The *Sotalia* and *Tursiops* are normally separated from one another during show performances, training, and free activity by placement in separate tanks or by net gates. The larger performing tank at Antwerp provides both the space necessary for the two species to periodically intermingle and a convenient observational setting due to a series of underwater glass windows running the length of one side. Observations of intergeneric behavior between these two dolphin species were recorded during contact periods varying from thirty to ninety minutes.

Results

Past interactions

Within a few months of their arrival in 1977 at Antwerp, the three tucuxi were gradually introduced to the larger *Tursiops* living within the same facilities. Periods of contact and the number of *Tursiops* were gradually increased from daily thirty minute sessions to, eventually, the entire night together. During initial contact sessions, the *Sotalia* at first remained calm, but maintained their close social unit and would avoid the larger dolphins' approach by swimming away. As the two species slowly adjusted to one another, however, intergeneric behavioral displays increased in frequency (DE BLOCK 1979).

An alternating pattern of rough play behavior and calm swimming in intergeneric social groupings, occurring at varying intervals, developed during the times the two species spent together. Rough play behavior typically included the "baiting" of individual *Tursiops* on the part of the smaller dolphins with short charges and quick escapes. Body posturing and intense vocalizations often accompanied these episodes of aggressive play interactions between the two species. The *Tursiops* would frequently respond to the "baiting" by initiating chases with the tucuxi, featuring impressive leaps and rapid turns by the smaller dolphins (DE BLOCK 1979).

The *Sotalia* remained with the *Tursiops* during certain periods of the day and every night for eighteen months after their initial adjustment. Apparently, some close social and affectional bonds were established during this period, especially between the female tucuxi and a large *Tursiops* male. Whenever behavioral interchanges became too aggressive or irritating, tail slaps on the water surface by the bottlenosed dolphins usually sufficed to terminate the displays. During their peak mating season in 1980, however, one of the male *Sotalia* was badly injured by a male *Tursiops* after repeated aggressive taunts toward the larger dolphin (DE BLOCK 1979). Since that time, the two species have been separated and intergeneric contacts are allowed only on a very limited basis.

There is one time period (varying from sixty to ninety minutes) during their present daily routine when the *Sotalia* and *Tursiops* are physically separated by a net gate but are still able to interact. In fact, large segments of this daily time period are spent in vigorous

body posturing (short charges toward the gate and jaw-biting motions) and profuse vocal exchanges between the two species. Individual bottlenosed dolphins come and go during this activity, but they never seem to reach the agitated state evidenced in the smaller tucuxi.

Present observations

Beginning in November of 1982, cautious attempts to re-integrate the two dolphin species on a limited and carefully supervised basis were initiated. Various interspecific ratios were tried for periods that fluctuated from forty-five minutes to ninety minutes. Intergeneric behavioral displays varied from case to case during these sessions and will be discussed in their individual contexts.

Case 1: One Sotalia (male) and four to six Tursiops (male and female)

On two occasions, individual male *Sotalia* were introduced separately to a varying number of *Tursiops*. In one instance four females were present, and in another all six bottlenosed dolphins were involved (including two males). The pattern of intergeneric behavior on these occasions, involving different male tucuxi, was remarkably similar. The small male, first isolated in the main pool, initially appeared nervous – a normal reaction when individual *Sotalia* are separated from the group. With the introduction of the *Tursiops*, typical signs of agitation were displayed by the smaller dolphin, including rapid swimming in tight circles and porpoising leaps out of the water.

In each case the individual *Sotalia* calmed down after about ten minutes and chose a larger female to accompany. When a second female or male *Tursiops* nipped at the smaller dolphin, the protector female would give several jaw-clap warnings, aggressively chase the other *Tursiops* away, and then rejoin the small male. On each occasion, the protector female eventually initiated a series of physical contacts with the smaller dolphin, using her rostrum to gently push the *Sotalia* up-and-down and roll his body in circles. Other bottlenosed females joined in this behavior, until all of the larger dolphins (including the males in one instance) were nudging, pushing and rolling the smaller male, and, occasionally, cradling him between their flippers. From the beginning, the male *Sotalia* remained passive; at the peak of the interactions he was motionless, allowing all manipulation. He made no attempt to swim away or offer resistance, showed no apparent signs of anxiety, and kept his eyes closed throughout much of the display. During one of these periods of manipulation, the little male was pushed to the bottom of the pool by three of the larger females and held there for fifteen to twenty seconds. Again, he remained passive until released. After a period of mostly one-sided manipulation lasting from ten to fifteen minutes, the tucuxi continued swimming closely (often flipper-to-flipper) with his original *Tursiops* protector until the session was terminated.

Observations at a later date, involving a similar intergeneric ratio (a single male *Sotalia* and three female *Tursiops*) showed similar interactions; however, one behavioral variation was notable. On this occasion, a large, female bottlenosed dolphin initiated contact at the onset with an intriguing display. Her first approaches to the male were forceful and sexual in appearance. Positioning herself beside the male, she maneuvered the edge of the *Sotalia*'s fluke into her genital slit. This action was repeated several times, and eventually the two other female *Tursiops* adopted similar displays toward the smaller dolphin. The male remained passive in each instance, allowing the females to position themselves.

Although this behavior seemed visually to be a sexual contact, the aggressiveness of the displays and the assertion shown by the *Tursiops* toward the *Sotalia* was more indicative of dominance behavior. Following these initial displays, the more gentle rolling and pushing manipulations (described earlier) commenced. As in previous cases, the tucuxi male remained basically passive. The female bottlenosed dolphin which participated least

directly in the initial sexual/dominance displays was later chosen by the *Sotalia* as a protector.

Case 2: Three Sotalia (two males and one female) and six Tursiops (two males and four females)

At the beginning of this intergeneric association, the three *Sotalia* first maintained their social group identity with no apparent signs of nervousness. After approximately fifteen minutes of little interaction, both male *Sotalia* began aggressive play behavior with individual *Tursiops*. After several close passes, the smaller dolphins made short sprints toward a selected bottlenosed dolphin, breaking away at the least instant short of actual contact. Eventually, these short sprints ended with the male tucuxi striking the *Tursiops* in mid-body, turning just before contact and thumping the larger dolphins with their backs. These strikes usually initiated a short chase, with the *Sotalia* evading the *Tursiops* through quickness, speed, sharp turns and occasional leaps out of the water. As the aggressive play escalated, the attacks on individual bottlenosed dolphins became more coordinated and intense on the part of the *Sotalia*, with the two males "stalking" individual *Tursiops* before charging. The female *Sotalia* participated in some of the aggressive displays but never to the extent of the males. The *Tursiops* initially seemed to interact positively in this behavior and sometimes encouraged or even initiated it. As the aggressiveness of the play increased, however, their agitation became apparent. When the interchanges became too vigorous, the session was terminated by the staff.

Case 3: Two Sotalia (male) and three Tursiops (female)

On one occasion, after a single male *Sotalia* was first allowed time alone with three female *Tursiops* (described at the end of Case 1), he was joined by the second male in the main pool. The behavioral atmosphere existing prior to the second male's entrance was suddenly and vividly altered. The two tucuxi quickly formed their normal, close social alliance. The bottlenosed dolphins did not then attempt contact or overt interaction with either *Sotalia*. An uneasy coexistence was maintained for ten minutes, with the two species swimming throughout the pool while maintaining distance from one another.

The mood of the dolphins seemed to grow more tense, and aggression between the two species escalated through stages. First, the two males "faced-off" with a large female *Tursiops* at one end of the pool. Positioned head-on at the surface of the water with the two *Sotalia* side-by-side, a constant distance of two meters was maintained between the two species for some minutes. As the larger dolphin slowly edged forward, the two tucuxi gradually backed up, vocalizing vociferously. The encounter was finally broken by the intervention of the other two *Tursiops*.

Next, one male *Sotalia* initiated a series of aggressive behavioral displays. Beginning with open jaw and rapid biting displays, coupled with sharp flipper movements, his behavior escalated to sudden charges toward selected *Tursiops*. The second male soon took up similar displays and overt actions, increasingly in concert with the first male. The three bottlenosed dolphins responded by bunching and began swimming nervously in a large circular pattern around the edge of the pool.

Finally, the two small males began boldly pursuing the larger dolphins, not as much in chase as in a stalking pattern, maintaining a tighter, inner circle around the pool (Fig. 1). As they followed the movements of the *Tursiops*, the two *Sotalia* periodically chose individual bottlenosed dolphins, seemingly at random, for sharp, coordinated attacks (quick charges and subsequent body slams). They would then re-form their original, inside circular position and stalking pattern. As the *Sotalia*'s aggressive pattern intensified, the curator terminated the contact session by separating the two different delphinids.

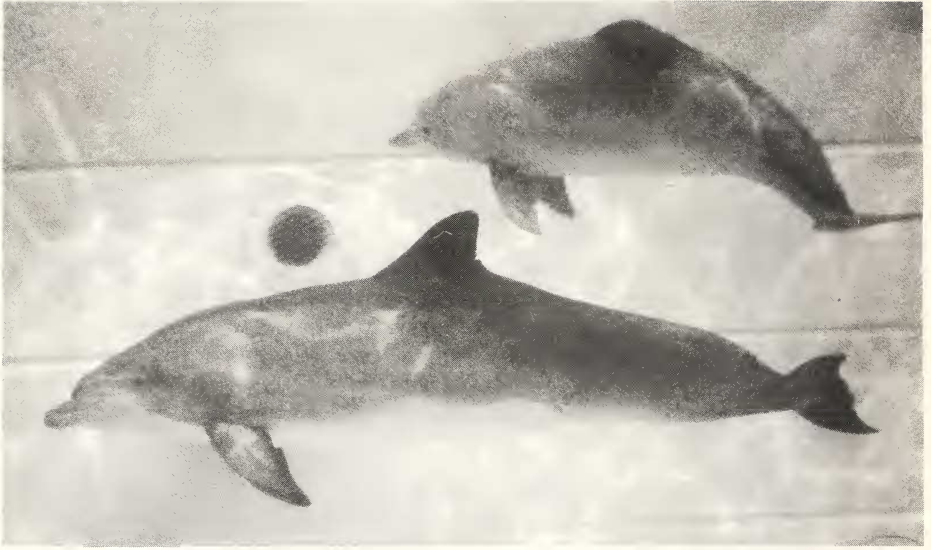


Fig. 1. A male *Sotalia* (foreground, top right) "stalks" a female *Tursiops* during aggressive interactions. (Photographs 1-3 by the author)

Case 4: Three Sotalia and one Tursiops (female)

During March and April of 1983, all three tucuxi were allowed, on numerous occasions, to swim with a single *Tursiops* for one hour sessions. The bottlenosed dolphin was an older female with an especially tolerant and gentle nature. During past interactions, she was frequently chosen by individual *Sotalia* as a protector. The intergeneric behavior observed during these sessions can be separated into several broad categories. Behavioral episodes within any one of these categories were displayed separately and did not overlap in time.

Passive social interactions were characterized by calm periods of swimming, often as a single intergeneric social group but without any direct physical contacts or overt communicative displays (such as body posturing, stroking, aggressive warnings). A characteristic swimming pattern in a counter-clockwise circle was usually established with the larger *Tursiops* taking a lead position, often with eyes closed. The three *Sotalia* established positions beside the posterior portion of the larger dolphin's body, the female close behind the left flipper, one male just to her side and the other male slightly posterior and above the other two. This formation would sometimes hold for ten to fifteen minutes, portions of which were spent in synchronous breathing. The female *Sotalia* would frequently leave and rejoin this pattern, but the males typically remained with the larger female dolphin, sometimes in close flipper-to-flipper, or flipper-to-dorsal fin proximity (Fig. 2). This loose, intergeneric social unit occupied the majority of the two species' time together.

Active sexual and affectional interactions between the two species involved both heterosexual and homosexual displays. Sexual behavior coincided with the normal captive mating season of both species. Homosexual behavioral interactions between the two females would commonly include stroking (using the fluke to stimulate the flipper in an up-and-down motion), body rubbing (along the sides and back to belly) and insertion of a fluke edge into the genital slit. Most of these actions were initiated by the female *Sotalia*; once initiated, however, they often occurred reciprocally. Other forms of stimulation included the use of the rostrum (on the part of the *Tursiops*) to push the genital area of the smaller female, and pushing at the base of the peduncle of the *Tursiops* by the *Sotalia*. At



Fig. 2. Two male *Sotalia* (foreground) and a female *Tursiops* (background) in a common intergeneric swimming formation

one point, the female tucuxi used a typical male courtship display for solicitation by swimming in the belly-up position in front of, and below, the larger dolphin.

Almost all heterosexual displays between the two species were initiated by the same male *Sotalia*. The courtship behavior in these instances were confined to limited body rubbing and prolonged swimming by the male in the belly-up position underneath, and to the rear, of the larger female (Fig. 3). Frequent erections were observed. Although the bottlenosed dolphin was not fully receptive and did not cooperate with the advances of the small male, she gave no warning or threat displays and did not actively attempt to swim away. Much of her behavioral response seemed ambivalent. No successful intromissions were observed between the two species, but on at least two occasions attempts at copulation and body rubbing resulted in ejaculations outside of the female's body. Intergeneric heterosexual displays between the *Tursiops* and male *Sotalia* were observed to occur both before and after intraspecific courtship and copulatory behavior between *Sotalia*. The second male *Sotalia* was never observed to engage in overt sexual behavior with the larger female dolphin. Indeed, he would normally swim complacently, and in close contact, with the *Tursiops* while the two other tucuxi engaged in sexual behavior.

Active aggressive interactions were characterized by vigorous physical contact, including body slams, and subsequent chases between the female *Tursiops* and *Sotalia*. Similar interchanges have been noted earlier between the small tucuxi and other bottlenosed dolphins. The body slams, normally initiated by the male *Sotalia*, took two forms. If the short, quick charge was made from an intersecting angle, contact occurred with the *Sotalia* turning his body at the last moment and slamming the larger *Tursiops* with the middle of his back. If the charge, however, was made head-on, the *Sotalia* would lower his head just before impact and strike the body of the *Tursiops* with the melon portion of the head and not the potentially more dangerous rostrum. The larger dolphin usually seemed aware of the imminent charge, presumably alerted by either visual or auditory cues, and would turn her side or back to the small dolphins. Frequently, the strikes became coordinated between the two males (occasionally joined by the female *Sotalia*), and gradually increased in frequency and intensity until the impacts were easily audible to an observer as loud "thumps".

At the peak of activity and excitement, chases sometimes included a series of aerial displays in the form of porpoising by the *Tursiops*, frequently joined by one or both male *Sotalia*. Although the strikes by the small dolphins did not appear to cause real pain, they seemed to irritate the *Tursiops* as their intensity escalated. The larger female appeared capable of breaking off the attacks with a quick chase, by the use of an open mouth gesture, or by jaw-claps. On all occasions observed, the aggressive interactions between the dolphins ceased on their own accord, often ending with the two species once again swimming quietly together in a loose social group.



Fig. 3. A male *Sotalia* (bottom) attempts to copulate with a larger, female *Tursiops*. A second male *Sotalia* is at the upper left

Discussion and conclusions

Dolphins display characteristics and behavioral interactions of special interest to biologists and taxonomists. Most animal species tend to diverge genetically outward from individual social groups or breeding populations. This outward expansion eventually manifests itself in variation and, ultimately, speciation. Cetaceans, however, also demonstrate a tendency toward inward genetic convergence, particularly evidenced in the behavioral domains. Although as a group they display tremendous variety in form and choice of habitat, when placed together artificially they often show remarkable behavioral affinities in displays of social interactions, epimeletic (care-giving) and sexual behavior. If a primary function of zoological taxonomy is to demonstrate the relative closeness of animals to each other, captive observations of behavioral interactions between members of disparate genera should be carefully considered. Intergeneric behavior in dolphins is not limited to captive environments and poses fundamental questions concerning the true distinctions between cetacean taxa.

Sexual displays and copulatory behavior between different dolphin species are not uncommon in captivity. SPOTTE (1967) and CALDWELL and CALDWELL (1970) reported aggressive intergeneric sexual behavior between captive *Sotalia fluviatilis fluviatilis* and *Inia geoffrensis* (in both cases, *Inia* was the aggressor, and the *Sotalia* were immature males). PRYOR (1973) reported a successful intergeneric mating between a female rough-

toothed dolphin (*Steno bredanensis*) and a male *Tursiops truncatus*, producing a healthy hybrid. In addition, LEATHERWOOD and REEVES (1983) report hybrids from matings between captive bottlenosed dolphins and Risso's dolphins, as well as false killer whales and a short-finned pilot whale. The evidence of successful intergeneric sexual activity does not appear to be limited to captive situations. F. C. FRASER (1940) described a group of wild, young dolphins stranded on an Irish beach as possible hybrids, demonstrating attributes of both bottlenosed dolphins and Risso's dolphins (*Grampus griseus*). Significant to the present study, VAN BREE (1975) has presented evidence that *Tursiops truncatus* and the coastal tucuxi, *Sotalia fl. guianensis*, overlap in habitat distribution at least in some areas of the Southern Caribbean (individuals of both species have stranded on the island of Trinidad).

Two points are of specific interest in the present study. First, only one of the male *Sotalia* attempted to copulate with a female *Tursiops*. The other small male, in fact, would swim passively and in physical contact with the larger bottlenosed female while the other two *Sotalia* engaged in mating behavior. Second, behavioral reactions of female *Tursiops* to a solitary male *Sotalia*, and vice versa, show remarkable similarities to maternal behavior. Very similar interactions (body rolling and pushing with a passive acceptance on the part of the smaller dolphin) were observed by the author between a female killer whale and her calf at Marineland of the Pacific in the summer of 1982. This behavior stimulates interesting speculations on the role of body proportion and size in the initiation of redundant maternal behavior on the part of the larger females, and its reciprocation by the smaller dolphin in the form of regressive juvenile behavior.

The pattern of intergeneric behavior between the two dolphinid species is distinctly different when the *Sotalia* are separated and not allowed their normal social unit. Aggressive interactions between the species, in particular, occur only when two or more of the tucuxi are present and seem to be independent of the number of *Tursiops*. On the other hand, a passive acceptance of physical contacts initiated by the larger bottlenosed dolphins was evident when individual *Sotalia* were separated from the other two. Passive social interactions (such as swimming in unison) occur regardless of the combinations of *Sotalia* and *Tursiops* in the same tank. The aggressive interactions observed in the present study corresponded closely to similar exchanges noted by DE BLOCK (1979) shortly after the *Sotalia* arrived in Antwerp.

The present study offers evidence for aggressive behavior on the part of *Sotalia* directed toward another dolphin species. This behavior is especially striking in the escalating nature of the displays and the extent to which the *Sotalia* (particularly the males) coordinate their attacks. Whether similar behavior is shared by the riverine *Sotalia fl. fluviatilis*, or indeed whether it occurs in the same manner in their natural environment, is unknown. Of special interest here, may be the role that this behavior serves in social and communitive functions, perhaps as a territorial display. A spacial factor may determine if, and to what extent, aggressive behavior occurs. GASKIN (1982) lists a number of factors that may lead to distorted captive behavior and suggests that the lack of necessary spatial resources can lead to frustrated pseudo-reproductive or aggressive behavior. Another report (CALDWELL and CALDWELL 1972) implicates the establishment of microterritories by cetaceans in captivity that may best approximate natural ecological preferences.

In the cases observed, it was often difficult to separate play behavior from true aggressive actions that serve to communicate warning signals. Certainly, these two forms of interactions appeared to overlap at some point, and in several cases seemed to evolve from one into the other. When only the male *Sotalia* were present (Case 3), the interactions appeared to be purely aggressive in nature. The gap separating the initial stimulus and later motivation is not easily bridged at present and may involve signals or cues not yet available to the observer. Further, in all of these observed interactions, there remained a large degree of individual behavioral expression that at times superceded generic limitations.

Many species of odontocete cetaceans demonstrate flexible, adaptive capabilities to captive environments, and the significance of behavioral interactions under such conditions needs to be critically evaluated. At the same time, however, the positive benefits of captive observations have been recognized, most recently by DEFRAN and PRYOR (1980), and unfortunately such observations have not been well reported to date. The fact remains that even with the limitations imposed by artificial associations, captive studies allow rare opportunities to view intergeneric behavior, difficult to observe in the wild, of cetacean species. At such times, it may be possible to gain new insights into mechanisms responsible for dolphin social organization and communicative behavior and a better understanding of taxonomic relationships. In light of the small amount of information available on *Sotalia*, the present study may provide a basis for future comparisons between the marine and freshwater subspecies of this small dolphin. Specifically, more observational emphasis may now be placed on behavioral adaptations to different environments, the role of communicative behavior in cetacean interspecific contacts, and the role of aggressive displays in cetacean social organization.

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Zusammenfassung

Intergenerisches Verhalten zwischen Sotalia fluviatilis guianensis und Tursiops truncatus in Gefangenschaft

Beschrieben werden erste Beobachtungen über Verhaltensweisen zwischen den Genera *Sotalia fluviatilis guianensis* und *Tursiops truncatus* in Gefangenschaft. Das intergenerische Verhalten zwischen Mitgliedern dieser beiden Delphinarten läßt sich in drei Grundkategorien zusammenfassen: 1. passive soziale Kontakte, 2. aktive sexuelle Kontakte, 3. aktive aggressive Kontakte. Wie weit diese Kategorien zum Ausdruck kommen, scheint bestimmt zu sein vom zahlenmäßigen Verhältnis der Einzeltiere und vielleicht durch ihr Geschlecht. Im allgemeinen zeigt *Sotalia* mehr Aggressivität gegenüber *Tursiops*, wenn ihre soziale Einheit erhalten bleibt. Einzelne männliche *Sotalia* neigen zur Passivität, wenn sie mit mehreren *Tursiops* zusammenkommen, und ihre Verhaltensäußerungen hängen von den größeren Delphinen ab. Das Verhalten bei der Werbung und Begattung zwischen einem männlichen *Sotalia* und einem weiblichen *Tursiops* wurde beobachtet.

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Age determination in the European otter *Lutra lutra lutra*

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Abstract

Aged carcasses of free living specimens of European otters *Lutra lutra lutra* from Norway by different methods. The numbers of dark-staining, incremental cementum lines observed in histological sections of teeth, the degree of cranial development, and the stage of development of the permanent dentition were compared. Based on the above information and the previously reported developmental stages of captive European, North American (*Lutra canadensis*) and African (*Aonyx* sp.) otters of approximately known age, the conclusion is that the number of dark-staining incremental cementum lines are likely to yield the approximate age in years. One source of variation in the relationship between an animal's age and the number of cementum lines in its teeth is the correlation of line formation with season of year, combined with the lack of a specific season of birth, at least over part of the natural distributional range of the European otter. Cranial development however, may be used to yield a more accurate estimate of age for otters up to 2 years-old. Dentitional changes are likely to have been completed before an age of 6 months and may thus yield additional information about the age of very young cubs.

Introduction

Reliable age determination techniques are essential for many aspects of biological studies. In the European otter *Lutra l. lutra* the possibilities for ageing specimens from their external characteristics are very limited, because of their rapid growth. Studies of captive otters show that one year-old animals are difficult to distinguish from older ones on size grounds. The fur difference between young and adult otters is slight and the fur has already attained its adult appearance at an age of 1½-2 years (REUTHER, pers. comm.). When carcasses are available for study a different range of morphological traits can be considered. BREE et al. (1966) devised a skull index and a baculum index for separating adult male European otters from subadults. STUBBE (1969) classified his otter carcasses as "first year of life", "second year of life" and "older than two years" on a basis of skull characters, the ischiopubic junction and, for males, the os baculum. This assessment was made intuitively, on the basis of knowledge of other mustelid species (STUBBE, pers. comm.).

Development of the method of using the dark-staining incremental lines visible in histological sections of teeth and bone for age determination has greatly improved the possibilities of making relatively reliable and accurate estimates of age, at all stages of the life-cycle, for many mammalian species. For several species of animals living in the Arctic